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# The Anthropocene could raise biological diversity

*Humanity has wrought an age of ecological transformations. It is time to rethink our irrational dislike of invading species, argues* **Chris D. Thomas**.

Human activity changes the environment, as last week's release of a report by the Intergovernmental Panel on Climate Change reminds us. But not all change is bad. One way in which animals and plants respond to warming temperatures, for example, is to move beyond their historical distributions, just as they do when they are transported to new regions by humans. The response of people who find themselves 'invaded' by such 'displaced' species is often irrational. Deliberate persecution of the new — just because it is new — is no longer sustainable in a world of rapid global change.

It is true that some invasive species damage ecosystems and can eradicate resident species. As a result, the European Commission, for example, is planning laws to control the 'adverse' impacts of species introduced through human activities, albeit without quite saying how those impacts should be defined. But the same process can also increase ecological diversity. On average, less than one native species dies out for each introduced species that arrives. Britain, for instance, has gained 1,875 established non-native species without yet losing anything to the invaders.

Human development — dubbed the age of the Anthropocene — boosts biodiversity in other ways too. New anthropogenic habitats, such as farmland and cities, usually support fewer species than the original ones, but they contain some that were previously rare or absent. The ensemble of new and old habitats holds more species than the original vegetation — habitat diversity is one of the strongest predictors of ecological diversity. Climate change also tends to boost regional diversity, because diversity increases with temperature and precipitation, both of which are rising (on average, but not everywhere). Global-diversity gradients dictate that more warm-adapted species are available to colonize new areas than cold-adapted species retreat from those areas as the climate warms.

Evolutionary origination is also accelerating. Populations and species have begun to evolve, diverge, hybridize and even speciate in new man-made surroundings. Evolutionary divergence will eventually generate large numbers of sister species on the continents and islands to which single species have been introduced. For example, marked reproductive incompatibility has developed in just 200 years between source populations of *Centaurea* plants in Spain and introduced populations of the same species in California. When should the citizens of California regard these plants as native?

Hybridization is becoming particularly important as formerly separated species are brought into contact. The rates are astounding: 88 hybrids between native and introduced plant species are sufficiently widespread to be mapped in the British Isles flora, as are 26 hybrids between two or more introduced species (together equivalent to 8% of the 1,377 higher plant species that have become naturalized following introduction). For example, introduced European *Rhododendron ponticum* plants hybridized with North American *R. catawbiense*, producing a vigorous, self-sustaining population that is hated by conservationists and removed at great expense.

**SPECIATION BY HYBRIDIZATION IS LIKELY TO BE A SIGNATURE OF THE ANTHROPOCENE.**

It is a mistake to misdirect valuable and increasingly scarce conservation funds into unwinnable wars, especially when the enemy is not especially damaging. Eradication programmes should concentrate on problematic non-native species, such as rats and goats on oceanic islands, where the investment can deliver long-term benefits and the re-establishment of native species. Trying to control Himalayan balsam throughout England, just because it is alien, is a waste of effort.

Speciation by hybridization is likely to be a signature of the Anthropocene. A new hybrid species of *Rhagoletis* fruitfly has colonized invasive honeysuckle in North America. A primrose species, *Primula kewensis*, arose by hybridization and continues to be propagated in London's Kew Gardens. And five species (*Spartina anglica* and four *Senecio* species) that have arisen by hybridization between native and introduced species in Britain have become naturalized. Remarkably, the introduction of plants to Britain seems to have increased the global species list. These five (out of a flora of 2,711 naturalized and native species) suggest a speciation rate (0.00184 per original species in the past 150 years) similar to the extinction rate reported for mammals over the past 100 years. If sustained, with no subsequent extinctions, it would be sufficient to increase the number of plant species by 20% within 15,000 years.

Rather than the catastrophic declines often portrayed, empirical evidence points to ecological increases in the number of terrestrial species in most of the world's regions over recent decades and centuries, even though the total number of species on the planet is declining.

We need more-concerted scientific investigation of the rates at which different processes generate diversity. Together, they could plausibly result in a net increase in the number of species on Earth during the Anthropocene (say, over a million years), despite the fact that we are losing irreplaceable populations, races, species and evolutionarily distinct taxa. There are excellent arguments for conserving the wildlife we already have, but it is less clear why our default attitude to novel biodiversity is antagonism or ambivalence. One recent hybrid species, *Senecio eboracensis*, became extinct soon after it arose in York, arousing little concern. In practice, it seems that new Anthropocene species are regarded as far less valuable than those that went before. ■

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